Application No.	: 10/522,948	Confirmation No.	: 4664
First Named Inventor	: Hong Jie DI		
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Examiner	: Courtney A. Brown		
Docket No.	: 101547.55778US		
Title	: Nitrification Inhibitor Treatment of Grazed Pasture Soils		

DECLARATION OF
PROFESSORS HONG JIE DI AND KEITH C. CAMERON
UNDER 37 C.F.R. 1.132

Mail Stop AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Hong Jie DI and Keith C. Cameron, hereby declare as follows:

1. I, Hong Jie DI, am a citizen of New Zealand and I, Keith C. Cameron, am a citizen of New Zealand.

2. We are each an inventor on this application no. 10/522,948.

3. We have read the Office Action dated October 15, 2009. The following remarks address the rejection of claims 59-100 under 35 U.S.C. 103(a) over Cookson et al. (Soil Biology and Biochemistry (2002) 34:1461-1465) in view of Sutton et al. (US Patent No. 4,994,100) and Smutek et al. (US Patent No. 4,560,796).

4. One of the reasons that nitrification inhibitors were not widely used prior to our invention is the lack of increased pasture production. The lack of pasture production meant there was no economic return from use of nitrification inhibitors. This is evident from the work by Turner and McGregor (1978) more than 30 years ago and is reinforced by the study by Cookson et al (Soil Biology &

Biochemistry (2002) 34:1461-1465) that also showed no pasture growth response to DCD application.

5. One of the surprises of our invention is that by treating substantially the whole area of a grazed pasture soil, including urine and inter-urine patch areas, with the DCD nitrification inhibitor in a solution form or crystalline or fine particle suspension form, we get increased pasture production in both the urine and inter-urine patch areas. This is evident from our published work reporting our results over four consecutive years (Moir et al. 2007, attached).

6. The increased pasture production in the inter-urine patch areas was wholly unexpected and is important economically because about 75% of the grazed pasture is inter-urine patch area . . . urine patches only cover about 25% of a grazed field on typical dairy farms in New Zealand. Therefore it is the extra pasture growth in the inter-urine patch areas that give the biggest agronomic return for the farmer that uses the nitrification inhibitor technology as described in our application.

7. Another major surprise is that this increased pasture growth in both the urine and inter-urine patch areas is achieved with only one application of the nitrification inhibitor in the Autumn and one application in the Spring. Before our invention, it was generally believed that the DCD effect in the soil is short-lived and repeated applications are required to sustain the inhibition effect. Our invention clearly shows that this is not the case and that just two applications can produce a significant effect on pasture growth.

8. A third major surprise is that these pasture responses and the benefits of decreased nitrate leaching and nitrous oxide emissions can be achieved by treating the grazed pasture soil with the nitrification inhibitor in a form, amount

and timing as specified in our application, rather than being applied together with the nitrogen source as the nitrification inhibitors were conventionally used prior to our invention. The separation of the inhibitor from the nitrogen source makes it possible for treatment of the urine patches that were deposited before or after the application of the nitrification inhibitor. It was a total surprise that such a treatment method was able to provide all the nitrate leaching, nitrous oxide emissions and pasture response benefits, which we described in our application.

9. Therefore, our invention contains some clearly inventive steps with results that were totally unexpected. It is these surprising features that make our invention a viable technology for the farmer to use.

10. The patent by Sutton et al. (1991) is very different from our patent application (no. 10/522,948) in at least three major aspects. One is that the Sutton et al. (1991) patent describes the conventional way of using nitrification inhibitors, that is by combining the nitrification inhibitor (e.g. DCD) with the nitrogen source (e.g. urea) to increase the nitrogen efficiency from the fertilizer that is treated. This is very different from our invention (no. 10/522,948) where the nitrification inhibitor DCD is applied <u>alone</u> without any nitrogen source applied with it. The purpose of the DCD application is to treat the soil nitrogen, including that from the animal urine. Because our invention is designed to reduce nitrate leaching and nitrous oxide emissions, it is applied during the wet cold season of the year, e.g. from late autumn through winter to early spring when nitrate leaching losses are high and plant growth rate is low. It would be inappropriate to apply the nitrogen fertilizer product as described in the Sutton et al. patent (1991) in large quantities during the wet cold season of the year, e.g. from late autumn through winter to early spring because the fertilizer is not taken up by the plant due to low temperatures and slow plant growth. In contrast, , our nitrification inhibitor technology without nitrogen

fertilizers can be used at these times of the year alone to treat the grazed pasture soils to reduce leaching and gaseous losses from animal urine that is deposited on the pasture soil.

11. The second major difference between our invention and the Sutton et al. (1991) patent is that the fertilizer in the Sutton patent is applied in granules of 0.84-4.76 millimeters, whereas in our invention, the DCD is applied in a solution form, crystalline form or fine particle suspension. This difference is fundamentally important. The reason for applying DCD in solution form, crystalline form and fine particle suspension is to treat the entire grassland soil surface uniformly so that every micro-site of the soil surface is treated. Soil ammonia oxidizing bacteria that are responsible for the conversion of ammonium to nitrate in the soil is everywhere in the surface soil. If DCD is applied in granular form, such as in a form as that in the Sutton et al. (1991) patent, the granules only cover a small fraction of the soil surface area, leaving large gaps of the soil un-treated between the granules. When animal urine is deposited on the soil, there will be ammonia oxidation and the production of nitrate will take place in the areas between the fertilizer granules. Therefore, if the fertilizer granules as described in the Sutton et al. patent are used to treat grazed grassland soils, it will not be very effective in reducing nitrate leaching or reducing nitrous oxide emissions from the animal urine patches due to the non-uniform treatment. This is in clear contrast to the very uniform coverage provided by the DCD applied in solution form, crystalline form or fine particle suspension form. Once the soil is treated by our nitrification inhibitor technology, the soil is uniformly treated, so the nitrification process is inhibited no matter where the urine may be deposited in the grazed grassland.

12. The third major difference between our patent and the Sutton et al. patent is that that Sutton et al patent does not recognise that urine patches are the main

sources of nitrate leaching and nitrous oxide emissions, and therefore the importance of treating these urine patches to reduce nitrate leaching and nitrous oxide emissions. No animal urine returns are mentioned in the document. The recognition of urine patches as a main source for nitrate leaching and nitrous oxide emissions is important because it affects the timing of application of the nitrification inhibitor (DCD). It is recommended in our nitrification inhibitor technology to apply DCD shortly after grazing when the urine patches are still fresh for DCD to be effective in late autumn and early spring. The Sutton patent does not make any comments on the importance of urine patches in nitrate leaching and nitrous oxide emissions, and makes no mention of timing the application in relation to urine deposition.

13. These differences are fundamental in nature between our patent application and the Sutton et al. (1991) patent. The Sutton et al. (1991) patent discloses a formulation of the granular fertilizer product, which contains a nitrification inhibitor to increase the efficiency of the nitrification fertilizer. Our patent application describes a method of use of a nitrification inhibitor (DCD) alone in a particular form (solution form, crystalline form or fine particle suspension) to treat substantially the whole of a grazed pasture soil, including urine and inter-urine patch areas at specified rates, timing and frequency to give a quantified sets of benefits: reducing nitrate leaching, reducing nitrous oxide and increasing pasture production in grazed pasture. Our patent application is therefore very different from the Sutton et al. (1991) application, represents inventive step in presenting a method of use of nitrification inhibitors in a manner that can reduce nitrate leaching, reduce nitrous oxide emissions and increase pasture yield in both urine and inter-urine patch areas.

All the statements made herein of our own knowledge are true and all statements made on information and belief are believed to be true, and these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

14 April 2010
Date

Hong Jie Di

14 April 2010
Date

Keith C. Cameron